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MAN'S MOST CREATIVE YEARS: THEN AND NOW

By Professor HARVEY C. LEHMAN

OHIO UNIVERSITY

IN previous articles the present writer has presented age-curves which set forth the chronological ages at which world-famous geniuses have either achieved or first published their best work.[1] The present study is an attempt to discover whether or not the age-curves thus far obtained are destined to hold for future as well as for past centuries. Although one can not be entirely certain as to what will happen in the centuries that lie ahead, it seems quite possible that a review of what has occurred in the past may provide one with a preview of what is likely to occur in the immediate future.

As a means of investigating the age-changes that may already have taken place the writer has partitioned some of his data upon the basis of the periods during which the various types of creative thinkers were born. In partitioning the data thus it was assumed that, if any change has already occurred in the chronological ages at which eminent thinkers have accomplished the various things which enabled them to attain recognition, this change would perhaps be revealed by study of the partitioned data.

For example, W. F. Magie's "A Source Book in Physics"[2] sets forth the chronological ages at which 140 notable contributions to the science of physics were either made or first published by 89 deceased individuals. In Fig. 1 the broken line sets forth the average number of contributions per ten-year interval for approximately the 50 per cent. that were earliest born, and the solid line sets forth similar information for the 50 per cent. that were most recently born. In both of these age-curves the average number of con-

[1] H. C. Lehman and W. S. Gamertsfelder, *Psychological Review*, 1942, 49; 319–344. (A bibliography of 9 articles of this series is to be found on page 343. In this list the 11th reference should be to the *Psychological Review* instead of to the *Psychological Bulletin*.

[2] W. F. Magie, "A Source Book in Physics." New York: McGraw-Hill Book Co., Inc., 1935. Pp. xiv–620.

tributions per ten-year interval was plotted in order to make proper allowance for the larger number of youthful research workers.

If, regardless of the number of workers that remained alive, the older age groups had contributed at the same average rate as did the younger age groups, both of the curves of Fig. 1 would remain as high at the older as at the younger age levels. Actually, both curves of Fig. 1 exhibit very noticeable and consistent decrements at the uppermost age levels, thus indicating that both groups of physicists became progressively less productive at the older age levels. Obviously, the foregoing statements hold only for creative work of the highest order; it may or it may not hold true for quantity of output.

Fig. 1 reveals that, as compared with the age-curve which sets forth data for the earlier-born group of

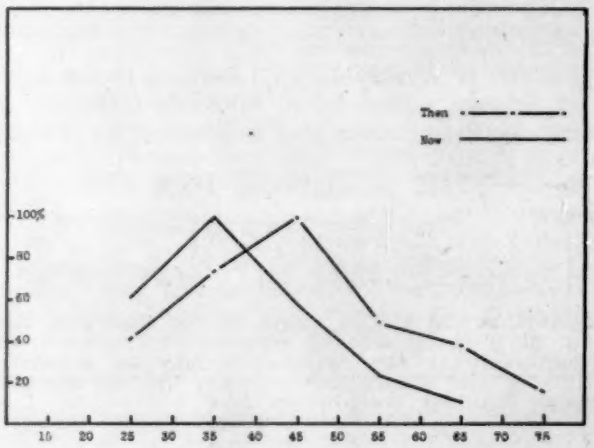

FIG. 1. Man's most creative years in physics: then and now. (Then) 60 contributions by 45 physicists born prior to 1785. (Now) 80 contributions by 44 physicists born from 1785 to 1867 inc. Data from Magie, W. F., "A Source Book in Physics." 1935.

physicists (the broken line), the curve for the more recently born group (the solid line) has the following characteristics: (1) It starts its ascent at the same age-interval, namely, at ages 20–29, inc.; (2) it rises more rapidly and it attains its peak ten years earlier, *viz.*, at ages 30–39 instead of at ages 40–49, and (3) it falls off at about the same rate of speed but, since the solid line starts its descent ten years earlier, the solid line is from 10 to 15 per cent. lower than the broken line at each age level from ages 45 to 65, inclusive.

Fig. 1 thus reveals that, as a group, the more recently born contributors to the science of physics have been somewhat younger at the time of making their world-famous contributions than were the earlier-born contributors. Somewhat similar findings have been obtained for the more recently born sub-groups of individuals who have contributed to the fields of geology, mathematics, invention, botany, pathology, classical descriptions of disease, medicine and public hygiene, literature, economics and political science, education and philosophy.[3] Since the findings for each of these sub-groups are presented herein in graphic form, they will require little comment. The general procedure for constructing the several age-curves has been similar for each type of eminent thinker. That is to say, for each of the sub-groups of contributors to a given field, an age-curve was drawn setting forth the average number of contributions per ten-year interval.[4] In each of these fields of endeavor it has been possible, therefore, to compare the output of approximately the earlier-born 50 per cent. with the output of the 50 per cent. that were more recently born.

Fig. 2 sets forth data for geologists, and Figs. 3 to 8, inclusive, set forth analogous information for

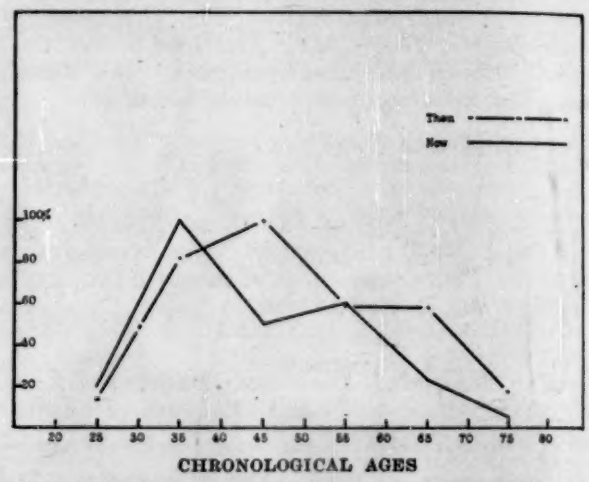

FIG. 2. Man's most creative years in geology: then and now. (Then) 84 contributions by 63 geologists born prior to 1800. (Now) 99 contributions by 65 geologists born from 1801 to 1857 inc. Data from Mather, K. F., and Mason, S. L., "A Source Book in Geology." 1939.

mathematicians, inventors, botanists, pathologists, classical describers of disease and contributors to medicine and public hygiene. For each of these types of creative thinkers the source from which data were obtained is given in the bibliography.[5-11] In general,

[3] In three fields of endeavor, namely, in chemistry, in astronomy and in oil painting, no significant age-change is discernible.

[4] Units of ten-year intervals will be used for the following age-curves unless otherwise specified. In constructing the graphs that accompany this article, the data for each of them were first reduced to a comparable basis by the following procedure: The peak of each statistical distribution was arbitrarily assigned a value of 100 per cent. and the other averages within the same statistical distribution were then assigned proportionate percentage values. For example, in Fig. 1, the peak of the distribution that is pictured by the solid line occurred at ages 30–39 inclusive. This modal value was taken to be 100 per cent. and the remaining frequencies by age-group were then computed and plotted as percentages of this modal value.

[5] K. F. Mather and S. L. Mason, "A Source Book in Geology." New York: McGraw-Hill Book Co., Inc., 1939. Pp. xxii–702.

[6] David Eugene Smith, "A Source Book in Mathematics." New York: McGraw-Hill Book Co., Inc., 1929. Pp. xvii–701.

these age-curves reveal that one or more of the comments already made with reference to Fig. 1 hold also for Figs. 3 to 8, inclusive.

Fig. 4 (inventions) is based upon data obtained from such well-known sources as "The Lincoln Library of Essential Information,"[7a] the "Standard Dictionary of Facts,"[7b] "The Scientific American Reference Book,"[7c] and so forth. Although in Fig. 4 the peaks of both age-curves occur at ages 30–39, it will be noted, nevertheless, that the curve for the more recently-born group (the solid line) rises more rapidly and it also

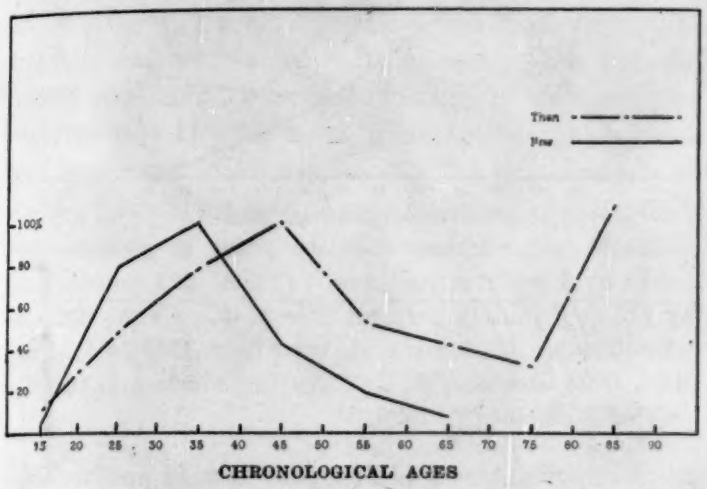

FIG. 3. Man's most creative years in mathematics: then and now. (Then) 54 contributions by 28 mathematicians born prior to 1748. (Now) 42 contributions by 27 mathematicians born from 1748 to 1848 inc. Data from Smith, D. E., "A Source Book in Mathematics." 1929.

falls off more rapidly than does the curve for the earlier-born individuals.

In Fig. 6 (pathology) the peaks of both curves likewise occur at ages 30–39, inclusive, and here too the

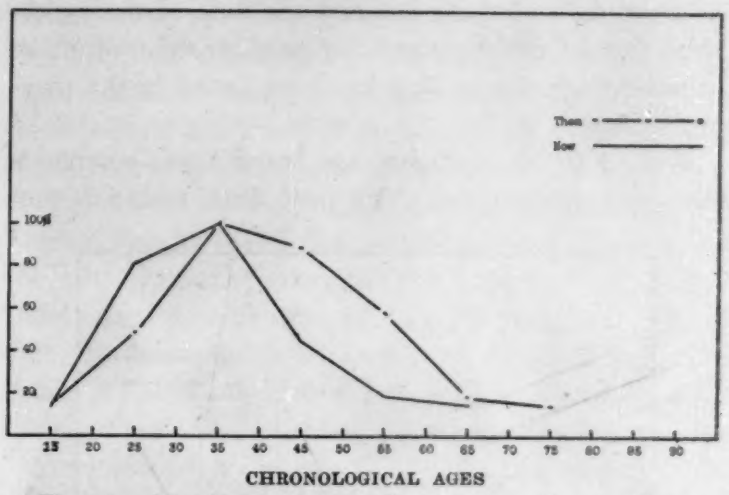

FIG. 4. Man's most inventive years: then and now. (Then) 154 inventions by 86 inventors born prior to 1750. (Now) 135 inventions by 86 inventors born from 1830 to 1850 inc. Data from various sources. See text.

curve for the more recently born group (the solid line) starts at a higher level and it also descends more rapidly than does the curve for the earlier-born. Fig. 6 thus suggests that, as compared with the more recently born group, the earlier-born group of pathologists were slower in starting to contribute and that they contributed more at the older age levels. It is, of course, possible that no genuine age-change has occurred as regards the average productivity of the several age groups but that only the time-lag between the date of discovery and the date of announcing the discovery has been decreasing during the past few centuries. Certainly, a large decrease in the amount of time-lag

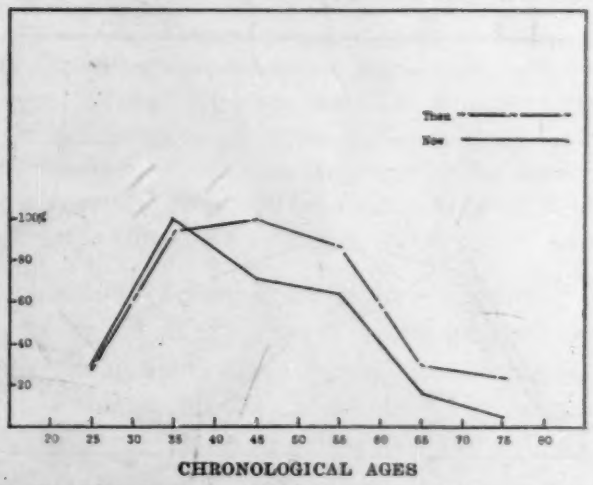

FIG. 5. Man's most creative years in botany: then and now. (Then) 91 contributions* by 53 botanists born prior to 1800. (Now) 144 contributions* by 50 botanists born from 1800 to 1854 inc. Data from Reed, H. A., "A Short History of the Plant Sciences." 1942.

* For the botanists it was not possible for the present writer to ascertain the exact number of different contributions. It was possible only to tabulate each time a dated contribution was mentioned in Reed's history. The same contribution may therefore have been counted more than once. The computations that were employed for constructing Figure 5 are based upon the foregoing procedure.

[7] (a) "The Lincoln Library of Essential Information." Buffalo, New York: The Frontier Press Co., 1934. (Modern inventions are listed on pp. 1336 *ff.*) (b) H. W. Ruoff (editor), "The Standard Dictionary of Facts." Buffalo, New York: The Frontier Press Co., 1910. (c) "The Scientific American Reference Book." Compiled by A. A. Hopkins and A. R. Bond. Munn and Co., publishers. Scientific American Offices. New York: 1905. Pp. viii-516. (See especially pp. 218–224 and pp. 216–*ff.*) (d) E. E. Irvine (editor), "The World Almanac and Book of Facts for 1938." New York: Published annually by *The New York World Telegram.* 1938. Pp. 64–960.

[8] H. S. Reed, "A Short History of the Plant Sciences." Waltham, Mass.: Published by the Chronica Botanica Company. 1942. Pp. x–320.

[9] E. B. Krumbhaar, (editor), "Clio Medico: A Series of Primers on the History of Medicine." XIX. Pathology by E. B. Krumbhaar, New York: Paul B. Hoeber, Inc., Medical Book Department of Harper and Brothers. 1937. Pp. xvii–206. (See pp. 157 *ff.*)

[10] Ralph Major, "Classical Descriptions of Disease." Springfield, Illinois: Thomas. 1932. Pp. xxvii–630.

[11] F. H. Garrison, "An Introduction to the History of Medicine." Fourth edition. Philadelphia and London: W. B. Saunders Co., 1929. Pp. 996. (A chronology of medicine and public hygiene is given on pp. 809 *ff.*)

between date of discovery and the date of announcement thereof could account for much or even all of the apparent age-change that has been found in the present study.

Figs. 9 to 13, inclusive, are based upon composite lists of contributions. The procedure that was em-

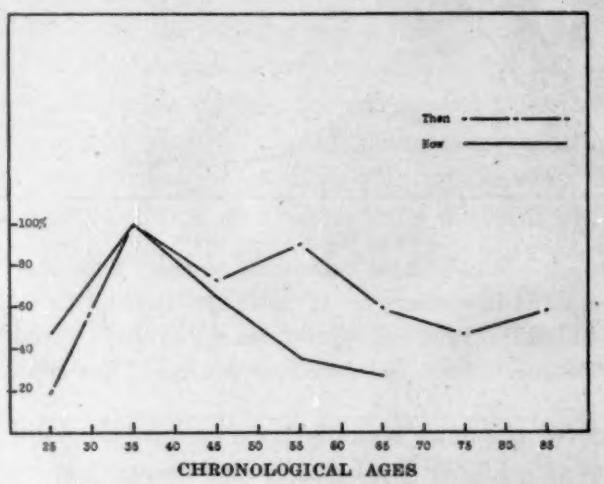

FIG. 6. Man's most creative years in pathology: then and now. (Then) 110 contributions by 88 pathologists born prior to 1773. (Now) 107 contributions by 84 pathologists born from 1773 to 1871 inc. Data from Krumbhaar, E. B., (editor). Clio Medica: "A Series of Primers on the History of Medicine." 1937.

ployed for obtaining each of these composite lists will be illustrated by describing the manner in which the data for the philosophical contributions were obtained. The most important philosophers were identified by canvassing more than 50 standard histories of philosophy. The foregoing procedure assumes: (1) That no

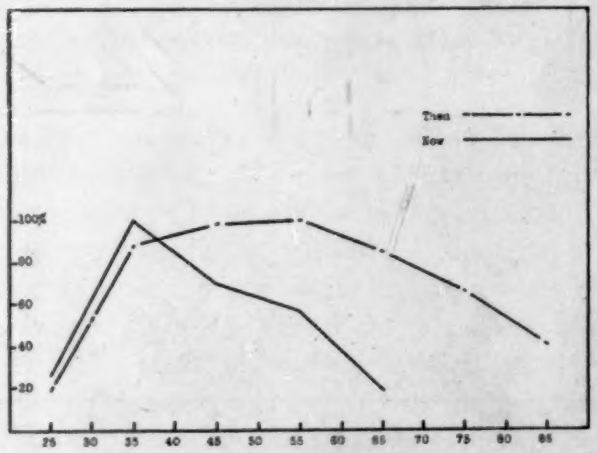

FIG. 7. Classical descriptions of disease: then and now. (Then) 67 classical descriptions of disease by 51 individuals born prior to 1759. (Now) 77 descriptions by 52 individuals born from 1760 to 1850 inc. Data from Major, R. H., "Classical Descriptions of Disease," 1932.

single authority is an absolutely safe guide; (2) that by careful collation of a large number of authoritative lists one can sift out the questionable names and be sure that no very important names have been overlooked, and (3) that the collective judgment of these professional historians is likely to be more valid than are the individual judgments when taken singly. It would seem to be a self-evident fact that a philosopher whose writings are mentioned and discussed in many of the standard histories of philosophy is likely to be

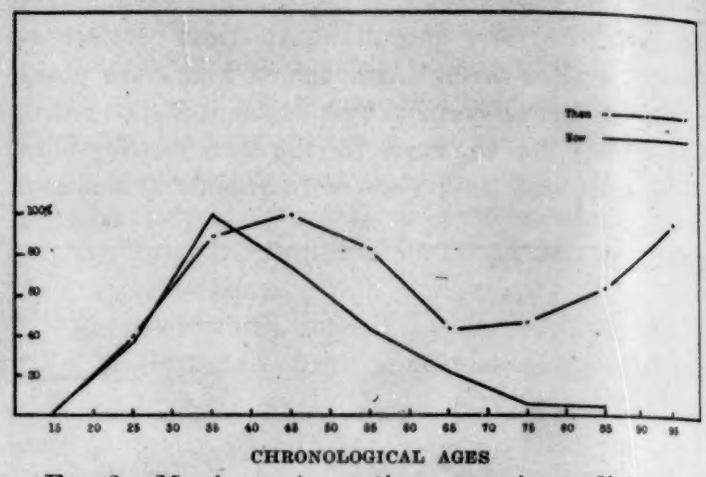

FIG. 8. Man's most creative years in medicine and public hygiene: then and now. (Then) 321 contributions by 215 contributors born prior to 1749. (Now) 407 contributions by 275 individuals born from 1750 to 1850 inc. Data from Garrison, F. H., "An Introduction to the History of Medicine." 1929.

more important as a philosopher than is another individual whose philosophical writings are cited and discussed in only a few histories of philosophy.[12]

In constructing Fig. 9 (philosophy) the writer has thus used the collective judgments of historians who

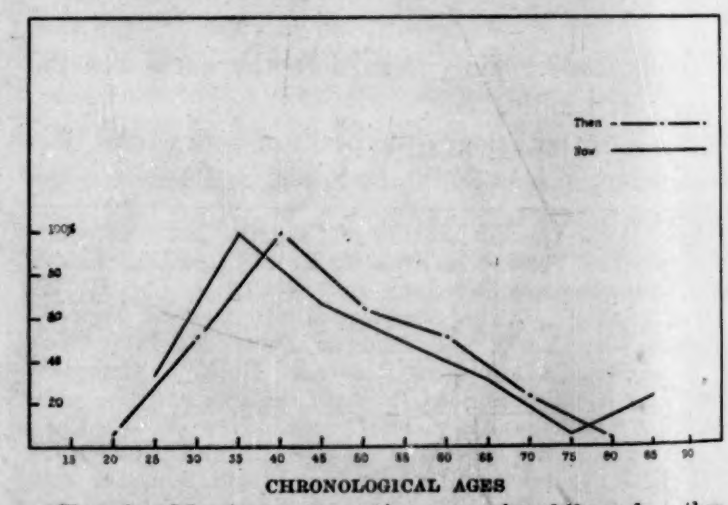

FIG. 9. Man's most creative years in philosophy: then and now. (Then) The one most significant work by each of 97 philosophers born prior to 1763. (Now) The one most significant treatise by each of 97 other philosophers born from 1764 to 1850 inc. Data from a composite list. See text.

have published their evaluations under their own signatures and who must, therefore, have tried conscientiously to cite and to discuss only the more impor-

[12] The names of 30 outstanding philosophers from various countries of the world are to be found in the *Psychological Review*, 1942, 49: p. 320, Table I. Important philosophical writings are listed on p. 322, Table II.

tant philosophical treatises. It also seems probable: (1) That this large number of independent critics did not concern themselves with the age factor; (2) that whether they were or whether they were not aware of the age factor, they probably have exhibited no constant prejudice for or against any one particular age group, and (3) that careful tabulation of the number of different histories in which a given philosophical treatise was cited and discussed should enable one to identify the really great philosophical works.

For each philosopher who wrote at least one book which appeared in as many as 5 different histories of philosophy, the philosopher's one most important treatise was ascertained. In selecting each philosopher's one most important writing it was assumed that the one treatise by a given philosopher which was cited and discussed in the largest number of standard histories was that particular philosopher's most important work. In this manner the 194 most important or significant works by each of 194 deceased major philosophers were identified. Fig. 9 reveals, both for the earlier-born 50 per cent. and for the more recently born 50 per cent., the average number of most important philosophical works that were either written or first published[13] during each ten-year interval of the authors' lives.

In the construction of Fig. 9 (philosophy), for the earlier-born group, the age intervals differ slightly from the age intervals that were employed in drawing Figs. 1 to 8 inclusive. In Figs. 1 to 8 inclusive, age intervals 20–29, 30–39 and so forth were employed. But, in constructing the broken line of Fig. 9, age intervals 15–24, 25–34 and so forth have been used. These latter age intervals were employed in constructing the broken line of Fig. 9 because it was found by trial-and-error that this method of plotting brings out more clearly the trend of the age changes that seem to have occurred as regards philosophical contributions.

Fig. 10 presents information regarding the chronological ages at which 190 notable authors either wrote or first published so-called "best books." The best books were identified in 1924 by Mr. Asa Don Dickinson, librarian of the University of Pennsylvania, who made a composite study of more than 50 "best book" lists. From Dickinson's[14] composite list the present writer identified the one "best book" by each[15] of 96 authors born prior to 1807, and also the one "best book" by each of 94 other authors who were born from 1807 to 1851 inc. In the construction of Fig. 10, no author's book was used unless the author had written at least one book which appeared as many as 5 times in Dickinson's composite list. Since most of the authors whose best books were employed in the construction of Fig. 10 wrote books which appeared more (some of them many more) than 5 times in the Dickinson composite list, it should be apparent that the foregoing minimum requirement for inclusion in Fig. 10 makes for a very severe selection. Indeed, for each kind of endeavor that is discussed herein, the criterion of selection is so high that the present study includes, with a few possible exceptions, only the *most* distinguished, who contributed within a given field, of whom there is historical record, and it includes (for each field studied) substantially all these.

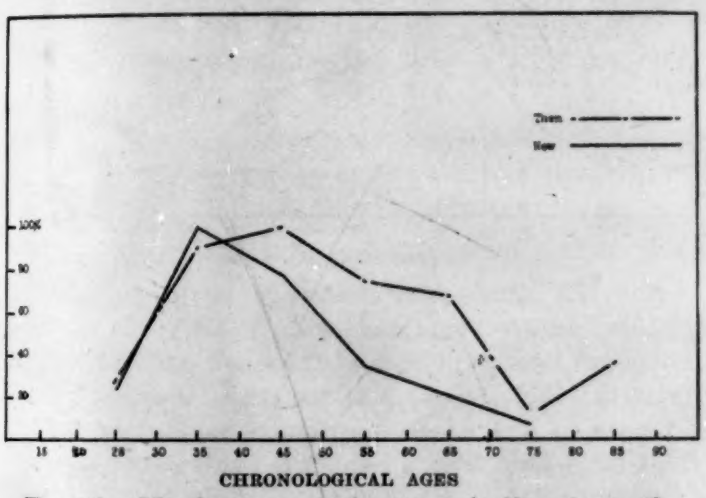

FIG. 10. Man's most creative years in literature: then and now. (Then) The one "best book" by each of 96 world-famous authors born prior to 1807. (Now) The one "best book" by each of 94 other world-famous authors born from 1807 to 1851 inc. Data from Dickinson, A. D., "One Thousand Best Books" 1925.

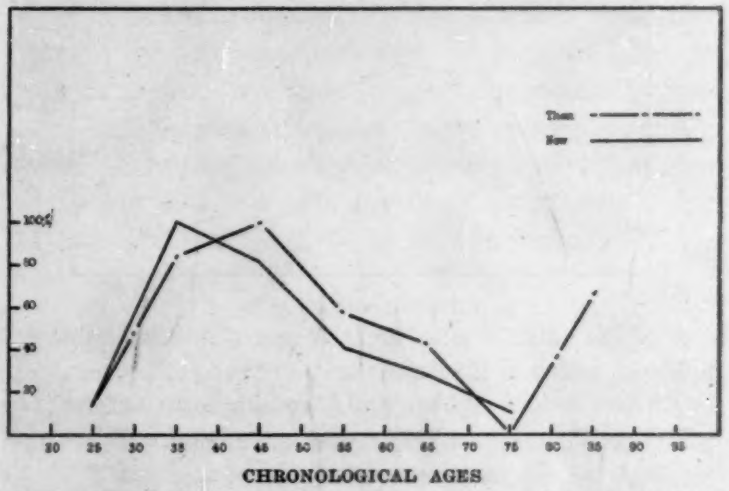

FIG. 11. Man's most creative years in education: then and now. (Then) The one most important treatise by each of 63 educational theorists born prior to 1743. (Now) The one most important writing by each of 60 other educational theorists born from 1744 to 1849 inc. Data from a composite list. See text.

[13] The dates of composition were employed whenever they were available. Wher dates of composition could not be obtained, the dates of first publication were used.

[14] A. D. Dickinson, "One Thousand Best Books," p. xii. Garden City: Doubleday, Page and Co., 1925. Pp. xvii–416.

[15] All authors for whom dates of birth and death and dates either of writing or of first publication were available.

Fig. 11 is based upon data obtained from 49 histories of education. The two curves of Fig. 11 reveal the ages at which the one most important book, report or educational plan was advanced or first published by each of 123 individuals, all of whom are well known in the history of education. No book, report or educational plan was employed in the construction of Fig. 11 unless it appeared in as many as 3 of the 49 histories of education. This was the minimum requirement for inclusion in Fig. 11. Obviously, most of the educational theorists whose works are included in Fig. 11 could have passed a much higher criterion of selection.[16]

Figs. 12 and 13 (economics and political science) are based similarly upon study of 20 books which deal

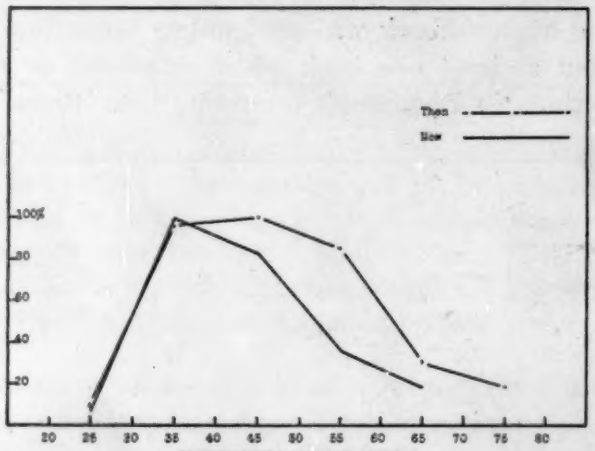

FIG. 12. Man's most creative years in economics and political science: then and now. (Then) The one most important treatise by each of 73 major contributors born prior to 1790. (Now) The one most important treatise by each of 69 major contributors born from 1791 to 1850 inc. Data from a composite list. See text.

with the history of those two subjects. Fig. 12 sets forth data regarding the one most important treatise by each of 142 individuals who wrote at least one book which appeared in as many as 4 of the 20 histories of economics and political science,[17] and Fig. 13 presents analogous information regarding 255 other individuals who wrote books which were cited and discussed in from 1 to 3 of the histories, *e.g.*, who wrote no book which appeared in as many as 4 of the 20 histories of economics and political science. Fig. 12 thus reveals the most creative years for each of two groups of major economists and political scientists and Fig. 13 sets forth comparable information for each of two groups of minor economists and political scientists. It seems apparent that for both the major and for the minor economists and political scientists the peaks of productivity were attained ten years earlier by the sub-groups that were more recently born.

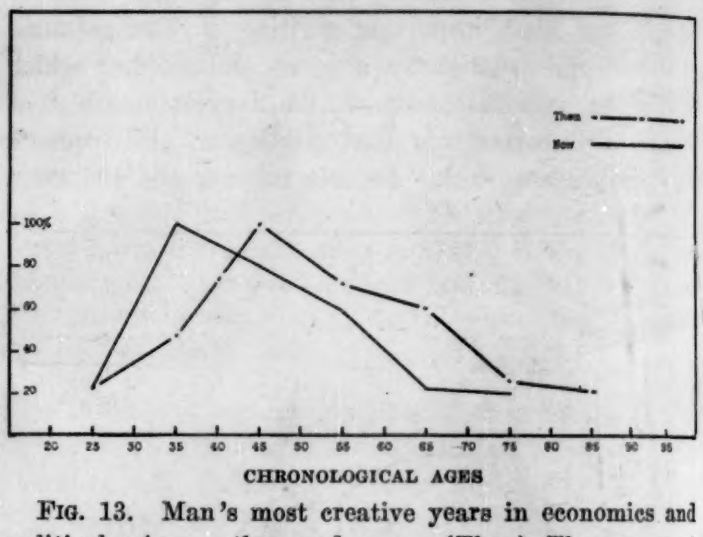

FIG. 13. Man's most creative years in economics and political science: then and now. (Then) The one most important treatise by each of 129 minor contributors born prior to 1790. (Now) The one most important treatise by each of 126 minor contributors born from 1790 to 1851 inc. Data from a composite list. See text.

CONCLUDING REMARKS

For 12 of the fifteen types of creative endeavor that have been mentioned in the present article, the contributions of the more recent era were made at younger age levels. For three of them, namely, chemistry, astronomy and oil painting, no significant age-change is evident. Just why 80 per cent. of the age-curves which reveal brilliant intellectual attainment should start their descents at earlier age levels for the more recently born individuals the present writer does not know. The following conjectures may account in part for the earlier peaks in the age-curves of the more recently born groups. However, they do not account for the more rapid descent of the age-curves of these sub-groups after the curves have attained their peaks.

(1) Chance factors have probably become less operative with the passage of time. (2) The early amateur investigators were more often self-educated; they had less opportunity to receive formal instruction and to experience the stimulation that is provided by groups of understanding colleagues. (3) The early workers possessed fewer ready-made tools or tech-

[16] The following is a list of the seven most outstanding educational treatises, giving the author, the book or treatise and the number of histories of education discussing it. J. J. Rousseau, "Emile," 40; J. A. Comenius, "Great Didactic," 38; John Locke, "Some Thoughts Concerning Education," 35; John Milton, "Tractate on Education," 35; Roger Ascham, "The Schoolmaster," 31; F. Froebel, "The Education of Man," 30; J. H. Pestalozzi, "Leonard and Gertrude," 30.

[17] The six most frequently discussed works in economics and political science, by author, book or treatise and number of histories of economics and political science discussing it follow. Adam Smith, "Wealth of Nations," 16; F. List, "Das Nationale System der Politischen Oekonomie," 14; T. R. Malthus, "Essay on Population," 14; David Ricardo, "On the Principles of Political Economy and Taxation," 14; Karl Marx, "Das Kapital," 13; J. S. Mill, "Principles of Political Economy," 13. Further research would no doubt change the relative amount of credit that is assigned to specific works. This change would probably not alter the shapes of the age-curves appreciably.

niques. These research devices had not yet been invented or discovered. (4) During the last few centuries, avenues of publication have increased very greatly in number. Moreover, both the demand and the reward for creative thinking have been growing. (5) According to Florian Cajori,[18] prior to about the beginning of the eighteenth century, mathematicians often deliberately withheld their discoveries as a means of preserving and enhancing their prestige (see Fig. 3). (6) The time-lag between date of discovery and the date of publication thereof may have been decreasing during the past few centuries.

Although the foregoing speculations may account in part for the finding that the contributions of the more recent era tend to occur at younger age levels, these speculations are rather inadequate. Perhaps it will be just as well if we confess our ignorance and ask not why this change has occurred but rather confine our attention to what has happened. At this point the present writer finds himself in hearty agreement with Professor Harvey B. Lemon, who, with reference to certain researches in the field of physics, has written:

> Our investigations into these things have but begun. What we do not ourselves understand any too well we cannot, naturally, explain fully to others.[19]

It has been suggested to the present writer that, whereas, in former days significant scientific contributions could be made often by youthful investigators who possessed relatively meager knowledge and background, to-day it may perhaps be necessary for the potential contributor to possess more extensive experience and a much larger fund of knowledge if he is to display effective and profound originality. It has also been argued that, because of our present greater average length of life, as compared with the average of previous centuries, maximum intellectual fecundity in the future will also tend to occur at older age levels.

The foregoing data reveal no factual basis for supposing that the most important creative work of the present day is being done by individuals who are older than the contributors of past centuries have been. Indeed, if any genuine age-change has been occurring (something more than a mere decrease in time-lag), the change seems to favor the younger rather than the older age-groups. And if a review of what has taken place in the past is an indication of what is likely to occur in the immediate future, it seems clear that there is no evidence whatever to support the hypothesis that future generations of creative thinkers will attain their peak output at increasingly older age levels. However, as was stated previously, this generalization does not hold for quantity of output but only for creative work of the highest merit.

OBITUARY

WILLIAM FOGG OSGOOD

WILLIAM FOGG OSGOOD was born in Boston on March 10, 1864, son of William and Mary (Gannett) Osgood. In July, 1890, he married Therese Ruprecht, by whom he had two sons and a daughter. In August, 1932, he married Céleste Phelps Morse, who survives him. He died on July 22, 1943.

Osgood was prepared for college at the Boston Latin School and became a member of the class of 1886. He took second-year honors in classics, and final highest honors in mathematics. There was little in the Harvard curriculum at that time to inspire a young man to give his life to mathematical research. The only member of the Mathematics Department, actively interested in scientific advance, was the youthful Benjamin Osgood Peirce, and his interest lay largely in the field of physics. But Osgood had early absorbed the idea that mathematics was the most difficult subject to be studied, and he meant to try for the biggest prize.

On graduation from Harvard he spent one more year in Cambridge as a graduate student, then went abroad for three years of advanced study in Germany. He spent the first two years in Göttingen, working especially under that prince of teachers, Felix Klein. His third year was in Erlangen, and there he took his doctorate. The years spent in Germany determined absolutely his whole future life. He married a German wife. He acquired such a mastery of German that his most important scientific writings were in that language. He adopted the German Weltanschauung to an extent that became somewhat embarrassing during the first World War. In the present crisis he saw matters in a different light. He received a mathematical impulse which guided his scientific thinking for the rest of his life.

Osgood returned to Harvard to teach in the autumn of 1890, thus beginning a connection which remained unbroken until the time of his retirement at the age of 69, in 1933. His was a distinguished and successful career. He saw the need for real improvement in the Harvard mathematical teaching. Byerly was an outstanding teacher in introductory courses, and J. M. Peirce was patient and conscientious, but there were others in the teaching force who lacked both

[18] F. Cajori, "A History of Mathematics," p. 133. Second edition. New York: The Macmillan Co., 1922. Pp. xiv–516.

[19] H. B. Lemon, "From Galileo to Cosmic Rays," p. 334. Chicago: The University of Chicago Press. 1934. Pp. xviii–450.

didactic skill and scientific interest. Osgood undertook to improve this situation. His teaching, whether of freshmen or graduates, was careful, clear and conscientious. He introduced a standard of rigor in Harvard mathematics which had been quite absent before. Many students received from him standards of absolute exactness and scientific honesty which lasted them through life. He wrote four text-books which were admirable for clearness and care. He never forgot the importance of linking up mathematics with physics. It is fair to say that to him this meant the application of classical mathematics to classical physical questions, rather than adapting new mathematical techniques to new physical demands.

Osgood pursued a life of scientific activity without haste and without rest. After his retirement from Harvard he spent two interesting years at the National University in Peiping, publishing two books, in English, which supplemented some of his earlier work.

He had returned from Germany at a critical moment when a number of young Americans, with training and ideals like his own, were determined to raise American mathematics to the standard of the subject in Europe. This was done partly by individual contributions, partly by founding and fostering the American Mathematical Society. Osgood was the eighth president. The essential quality of his own mathematical contributions, some seventy in number, was soundness. Whatever he wrote was rigorous and significant. He had a clear idea of what he believed to be of permanent importance in mathematical science, and that alone claimed his interest. He had no interest in the flashy or trivial. He was suspicious of devices which seemed too ingenious, fearing hidden difficulties. When a young man of thirty-two, he was invited to contribute one of the most important articles to the universal mathematical bible, the *Encyklopädie der mathematischen Wissenschaften*. His *Lehrbuch der Funktionentheorie*, which ran into no less than five editions, is the classical treatise on this fundamental subject. There was perhaps little change either in his scientific thinking or technique during the course of his career. In Germany he had such a large vision of the sort of work he would like to do, that its accomplishment and natural extensions sufficed for the whole of his productive life.

Osgood had two compelling loyalties, to mathematical science and to Harvard University. Utterly lacking in personal ambition, he had the highest hopes for the Harvard mathematical school. He took little share in the wider parts of university administration, but was characteristically conscientious in performing specific tasks, however monotonous. He was unwearied in his acts of kindness to individual students, and he treated all with an old-fashioned courtesy which sprang from his deep love for his fellow man.

JULIAN L. COOLIDGE
GEORGE D. BIRKHOFF
EDWIN C. KEMBLE

DEATHS AND MEMORIALS

DR. WILMON NEWELL died on October 26. Since 1915 he had been provost for agriculture at the University of Florida and a leader in the agricultural development of the state. He was appointed in 1920 dean of the College of Agriculture and director of the Experiment Station and the Agricultural Extension Service.

DR. THOMAS ANDREW STOREY, formerly director of the School of Hygiene at Stanford University, died on October 27 at the age of sixty-eight years.

PAUL BLAKESLEE MANN, who retired in 1941 as supervisor of science in the senior high schools of the New York City public school system after a career of forty years in teaching, died on October 22 at the age of sixty-six years.

DR. ELLIOTT SMITH, director of the Observatory of the University of Cincinnati, died by suicide on September 29. He was sixty-eight years old.

DR. WILLIAM WALDO BLACKMAN, professor emeritus of anatomy at the Flower and Fifth Avenue Hospitals of the New York Medical College, died on October 20 at the age of eighty-seven years.

THE Senate adopted on October 21 a resolution designating February 11, 1944, as Thomas Alva Edison Day. Under the resolution, which must have House approval, the President would be requested to issue a proclamation directing display of the flag on all Government buildings and inviting appropriate ceremonies in schools and churches or other suitable places.

SCIENTIFIC EVENTS

THE FORTIETH ANNIVERSARY OF THE FLIGHT OF A HEAVIER-THAN-AIR MACHINE

GOVERNOR J. MELVILLE BROUGHTON, of North Carolina, has issued the following proclamation:

Forty years ago, amidst the sand dunes at Kitty Hawk, North Carolina, two brothers, then obscure but since made famous, began experiments for the purpose of testing and confirming their conviction that machines heavier than air could be made to fly. In this seemingly fantastic endeavor, which was met with scepticism and even ridicule, they devoted many long hours and days of effort, experiment and frustration. Ultimately their efforts were crowned with success, and on December 17, 1903, the world was electrified at the announcement that for the

first time in history a heavier-than-air machine had on that day been successfully flown at Kitty Hawk. Thus the airplane was born. Its creators were the immortal Wright brothers, Wilbur and Orville: and its place of birth was Kitty Hawk, North Carolina.

The fortieth anniversary of this epochal event, December 17, 1943, will come in the midst of the greatest war in history—a war in which the airplane will be the decisive implement of victory for democracy, decency and righteousness in the epochal struggle against aggression, brutality and slavery.

Before this global war and its tragic consequences had thrown a shadow over the face of the earth, the airplane was already revolutionizing the transportation and communications of the world. This swift messenger of peace and friendliness as between nations, this harbinger of a new world of trade and good will, had already served to bring the world closer together. In the miracle of this winged swiftness the farthest nations of the earth had been brought closer together in understanding and in commercial relationship. After the carnage of war is over and when victory is crowned, the airplane, immeasurably stimulated in its production and perfection, will prove the indispensable agency for rebuilding a disordered and mutilated world.

Under these circumstances, it is altogether fitting that the anniversary date of this world-changing event should be appropriately observed at the place of its occurrence.

Now, therefore, I, J. Melville Broughton, Governor of the State of North Carolina, do hereby designate Friday, December 17, 1943, as Kitty Hawk Day, and do hereby call upon all citizens of North Carolina, and in so far as I may be privileged to do so all citizens of an America grateful for the achievement of the Wright brothers, to give suitable observance to this deeply significant event, and further do call upon all who are vitally connected with the airplane industry in America and upon representatives of the Army and Navy and governmental agencies to designate and delegate official representatives to attend a suitable observance of this event which will be held at Kitty Hawk, North Carolina, on December 17, 1943, when and where appropriate tribute can be paid to the memory of Wilbur Wright, now deceased, and to Orville Wright, the surviving member of this world-famous partnership endeavor.

In witness whereof, I have hereunto set my hand and caused the Great Seal of the State of North Carolina to be affixed at Raleigh, the Capital, this the sixth day of October A.D. 1943.

J. MELVILLE BROUGHTON,
Governor

PREFERENCE RATINGS FOR LABORATORY EQUIPMENT

THE Safety and Technical Equipment Division has issued the following explanatory statement (see SCIENCE, October 22, page 358) on preference ratings for laboratory equipment of all kinds.

Blanket MRO ratings, that is, ratings which are assigned without specifying the kind and quantity of material to which the rating is applied, may not be used for laboratory equipment, according to the provisions of Priorities Regulation No. 3. This restriction applies only to finished products and not to parts and materials for repair and maintenance of existing equipment. Such parts and materials may be purchased with blanket MRO ratings.

An exception to the rule against the use of blanket ratings is that ratings assigned under Orders P-43, P-56, P-58, P-68, P-73, P-89 and P-98b may be used for laboratory equipment even though they are blanket ratings. Blanket ratings assigned by CMP Regulation 5 and 5A may not be used, however.

Persons who need ratings and are not operating under one of these "P" orders should file PD 1A applications. However, where the purchase covers items on List A of Order L-144, the rating assigned in the authorized Form WPB 1414 may be used.

In reference to Order L-144 the division pointed out that the prospective purchaser should notify his supplier when he receives WPB authorization on Form WPB 1414 and should apply the authorized preference rating. Notification should be given by sending the supplier the certification described in paragraph (d)(2) of L-144 and the authorization should be retained by the purchaser.

A SURVEY OF MEDICAL COLLEGES

WILLIAM L. LAWRENCE contributes to *The New York Times* an account of a survey of seventy-two leading American medical colleges which shows that "the severe reduction in teaching staffs and the accelerated program" have resulted in a lowering of standards in a fourth of the colleges and threaten "a serious situation in medical education."

A report on the survey, made by the executive council of the Association of American Medical Colleges, was read at Cleveland at the annual meeting of the association by Dr. Willard C. Rappleye, dean of the Faculty of Medicine, Columbia University, chairman of the council.

Dr. Rappleye stated that "Many schools report that about a third of their most active and able teachers have gone into service. Upon those remaining have fallen the tasks of carrying the instructional load and the care of patients in the wards of the teaching hospitals which in a normal academic year would be a heavy burden. But the accelerated program which requires instruction throughout the calendar year places a demand upon the staffs still in the schools which can be met only for a limited time."

According to Mr. Lawrence, nineteen of the schools reported that their staffs were now below the number necessary to provide reasonably satisfactory instruction and are greatly overworked. Many of the other

fifty-three reported that they were at their minimum and any further withdrawals for military duty or by retirement or death would mean inability to maintain their programs.

From the data and comments obtained from the inquiry the following conclusions were drawn:

(1) Any further depletion of the instructional staffs of the medical schools will result in a serious breakdown of students of medical training. Already there is a definite deterioration of the quality of instruction in one fourth of the medical schools.

(2) The qualifications and educational preparation of trainees selected and assigned to the medical schools in the future must be kept high if even reasonable standards of academic performance are to be maintained under war conditions.

(3) If the present trend continues, consideration may have to be given to possible modification of the accelerated program to maintain proper instruction of medical officers for the Army and Navy and of physicians for the civilian needs of the future.

PERSONNEL PROBLEMS IN GEOLOGY

THE Office of Scientific Personnel of the National Research Council was established in 1941 primarily to aid in solving problems of scientific and technical personnel in connection with the activities of the National Defense Research Committee. During more than two years of its existence the office has handled successfully a large number of cases, chiefly in the field of physics, but also in other fields of science and engineering. The director of the office is Dean Homer L. Dodge, of the University of Oklahoma.

The needs of the Office of Scientific Research and Development and the availability of physicists and mathematicians have changed with the progress of the war. Therefore the Office of Scientific Personnel can now give more attention to fields other than those involved in the Office of Scientific Research and Development, some of which fields are suffering manpower shortages and can profit from the methods developed in this office for handling personnel problems in critical fields. The Geological Society of America is cooperating with several other scientific organizations to maintain the Office of Scientific Personnel for the remainder of 1943 and at least several months of 1944. During this time the effective machinery that has been built up by Dr. Dodge will be available to all geologists and their employers in the adjustment of wartime personnel problems.

The work of the Office of Scientific Personnel has been chiefly of two kinds: (1) placing qualified scientific and technical workers in positions connected with the war effort, and (2) taking steps to secure the deferment of scientists and technicians who can make their best contribution to the war effort by occupying civilian positions calling for their special skills. The office can serve in the first capacity to the extent that needs for geologists are reported and available geologists register. This service will be developed to meet the demand.

With respect to deferment problems, recent developments have made it uncertain how the office can best function. In the past, Dr. Dodge has assisted employers of physicists and mathematicians by writing letters to local Selective Service boards and state directors and by advising with officials in the National Selective Service Headquarters. Out of this work developed the National Committee procedure which is described in "Activity and Occupation Bulletin," No. 35, and which Dr. Dodge had hoped would be extended to include geologists in the near future. Instead, an entirely new procedure has been developed by the War Manpower Commission to be administered by the U. S. Employment Service.

The Division of Geology and Geography of the National Research Council has appointed a Committee of Geological Personnel, of which the chairman is W. B. Heroy, who is located in Washington. The primary function of this committee will be to coordinate personnel activities of the several geological societies; Dr. Dodge's office will consult with this committee in cases affecting geologists.

The Geological Society of America will prepare mimeographed statements of further helpful information as it becomes available. Those who have specific questions not answered in the present notice should address the Secretary, Geological Society of America, 419 W. 117th Street, New York, N. Y.

TERCENTENARY COMMEMORATION OF THE INVENTION OF THE BAROMETER, 1643–1943

A TERCENTENARY Commemoration of the Invention of the Barometer was held at the University of Toronto on October 19. There were afternoon and evening meetings.

Under the patronage of the Canadian Branch of the Royal Meteorological Society, the Royal Astronomical Society of Canada, the Royal Canadian Institute and the University of Toronto, two sessions were devoted to four papers indicating the origin and development of the barometer, discovered by Evangelista Torricelli in Florence in 1643.

The afternoon meeting was held in West Hall, Professor C. A. Chant presiding. The first paper was presented by Professor Louis C. Karpinski, of the University of Michigan, representative of the History of Science Society. This paper stressed the fact that Torricelli put together mentally the "force of the vacuum," 32 feet of water when the pump fails as

given by Galileo, the weight of the air as determined by Galileo, and the pressure and resistance of the air and "various other fluids," as discussed by Galileo in connection with projectiles, arriving at the idea that if water was held up to 32 feet, mercury would be held up under the same pressure to 30 inches, as mercury approximates 14 times the weight of water.

Dean G. S. Brett, of the department of philosophy of the University of Toronto, dealt particularly with the philosophical aspects of the "horror of the void" and the effect of the creation of a vacuum on contemporary thought.

The evening meeting was held in the McLennan Physical Laboratory, with Director John Patterson, of the Canadian Meteorological Service, presiding. A comprehensive collection of modern developments of the barometer and ancient devices was on exhibition. These were arranged by W. E. Knowles Middleton, of the Canadian Meteorological Office, with the cooperation of Professor John Satterly, of the department of physics. Mr. Middleton gave an account of these various contrivances which remain to this day so essential for attempts to forecast the weather. Dr. Satterley gave a survey of the difficulties of development of the barometer as a precision instrument.

One classical experiment given by Torricelli in 1644 involved having the bowl of mercury supporting the mercury column large enough to hold water on top of the mercury sufficient to fill completely the tube holding the mercury. On lifting the tube to the point in the bowl where the mercury and water meet, the mercury drops almost instantly, and the water completely fills the tube that held the mercury. This experiment was successfully performed at both sessions.

President Cody, of the University of Toronto, presided at a dinner where toasts were given to the King of England, to President Roosevelt and to the three American delegates, including Dr. Andrews, of the Cleveland Great Lakes Weather Bureau, and Mr. Brumbacher, of Washington, members of the American Meteorological Society.

AMERICAN-SOVIET CONFERENCE

A CONFERENCE, sponsored by the National Council of American-Soviet Friendship, for which the following program has been arranged, will be held in New York City at the Hotel New Yorker on November 7:

PANEL: SOVIET SCIENCE AND TECHNOLOGY, 11:00 A.M.–1:30 P.M.

Chairman: DR. HAROLD C. UREY, professor of chemistry, Columbia University.

Sir Hubert Wilkins, explorer, "Soviet Exploration and Geography."

Dr. Carl O. Dunbar, curator, Peabody Museum, Yale University, "Advances in Soviet Geology and Mineralogy."

Dr. Charles E. Kellogg, soil scientist of the U. S. Department of Agriculture, "Soviet Soil Technology and Agriculture."

Dr. L. C. Dunn, professor of zoology, Columbia University, "Soviet Research in the Biological Sciences."

Dr. Selman Waksman, professor of microbiology, Rutgers University, "Bacteriology in the Soviet Union."

Dr. V. K. Zworykin, research director, R.C.A. Laboratories, "Soviet Developments in Electronics."

General Discussion.

PANEL: PUBLIC HEALTH AND WARTIME MEDICINE IN THE U.S.S.R., 2:30–5 P.M.

(the American-Soviet Medical Society cooperating)

Chairman: DR. WALTER B. CANNON, professor of physiology, Harvard University.

Dr. Hugh Cabot, Boston surgeon, "Russian Medicine Organized for War."

Dr. C.-E. A. Winslow, professor of public health, Yale University, "Public Health in the Soviet Union."

Professor Vladimir Lebedenko, Soviet surgeon, "Russian Advances in Military Medicine."

Soviet Motion Picture, "Experiments in the Revival of Organisms."

Dr. W. M. Stanley, Rockefeller Institute for Medical Research, "Soviet Studies on Viruses."

Dr. Alice Hamilton, medical consultant to the Federal Department of Labor, "Industrial Medicine in the U.S.S.R."

Dr. Wilder Penfield, professor of neurology, McGill University, "The Recent Surgical Mission to the U.S.S.R."

General Discussion.

THE TENTH ANNIVERSARY OF THE PLANETARIUM AND MUSEUM OF THE FRANKLIN INSTITUTE

THE Franklin Institute, Philadelphia, will celebrate on November 9, at three o'clock, the tenth anniversary of the opening of the Planetarium and Museum. The first session will be held in the Fels Planetarium, Wagner Schlesinger, director of the planetarium, presiding. The speakers will be James Stokley, General Electric Research Laboratories, first director of the planetarium; Colonel Philip Fox, Signal Corps, U. S. A., first director of the Adler Planetarium, Chicago; Demonstration of the Planetarium Instrument, Colonel Fox.

After an intermission the proceedings will be resumed in Franklin Hall at 4:15 in the afternoon, Charles S. Redding, president of the Franklin Institute, presiding. The program for the afternoon follows:

"Then and Now," The Honorable George Wharton Pepper.

Presentation by the president: Certificates of Honorary Membership to Philip Fox, Samuel S. Fels, Mary Curtis Zimbalist.

Presentation of Walter S. Gifford, president of the American Telephone and Telegraph Company, for the Vermilye Medal, Richard T. Nalle.

Address: "Industrial Management and Freedom from Want," Walter S. Gifford.

Reception and tea by the Hostess Committee.

The medal was awarded to Dr. Gifford "in recognition of outstanding contributions in the field of industrial management."

SCIENTIFIC NOTES AND NEWS

AT the sesquicentennial commencement of Williams College, the doctorate of science was conferred on Dr. Alfred N. Richards, professor of pharmacology and vice-president in charge of medical affairs of the University of Pennsylvania, and on Professor Jerome C. Hunsaker, head of the department of mechanical and aeronautical engineering at the Massachusetts Institute of Technology.

AT the celebration on October 27 of the centennial of the School of Medicine of Western Reserve University, honorary degrees were conferred as follows: the doctorate of science on Professor George H. Whipple, dean of the School of Medicine and Dentistry, University of Rochester, and on Dr. Reginald Fitz, of the Harvard Medical School; the doctorate of humanities on Dr. Frederick C. Waite, professor emeritus of histology at the university, and on Dr. William T. Corlett, Cleveland dermatologist, and the doctorate of laws on Dr. Torald H. Sollmann, dean of the School of Medicine at the university.

DR. SHERWOOD MOORE, director of the Mallinckrodt Institute of Radiology of Washington University, St. Louis, has been appointed by Surgeon General Parran a member of the National Advisory Cancer Council.

NEVIN E. FUNK, vice-president in charge of engineering of the Philadelphia Electric Company, was recently elected president of the American Institute of Electrical Engineers.

DR. A. C. FURSTENBURG, dean of the Medical School of the University of Michigan, was named on October 27, at the closing session of the fifty-fourth annual convention, president-elect of the Association of American Medical Colleges.

H. P. TREVITHICK, of the bureau of chemistry of the New York Produce Exchange, has been elected president of the Association of Consulting Chemists and Chemical Engineers.

THE title of professor emeritus has been conferred by the College of the City of New York on Dr. Frederick G. Reynolds, formerly professor of mathematics and chairman of the department, and on Dr. Axel L. Melander, formerly professor and head of the department of biology.

DR. JOSEPH C. AUB, since 1928 associate professor of medicine in the Harvard Medical School, has been appointed professor of research medicine.

DR. ERNST GELLHORN, professor of physiology at the College of Medicine of the University of Illinois, has taken up his work as professor of physiology at the Medical School of the University of Minnesota. He has been placed in charge of a special unit in neurophysiology for the study of infantile paralysis, sponsored by the National Foundation for Infantile Paralysis.

DR. HENRY G. FISK, who has been in charge of ceramic and mineralogical research at the Armour Research Foundation of the Illinois Institute of Technology, has been appointed director of the newly established Research Institute of the University of Wyoming. He took up his new work on November 1. The Research Institute is the first institution of its kind in Wyoming. In conjunction with the university, its purpose is to aid by scientific research in the discovery, development and exploitation of the natural resources of the state.

DR. I. A. MERCHANT, associate professor of veterinary hygiene at Iowa State College, has been appointed head of the department. Dr. Fay Farnum, of New York University, has been appointed assistant professor of mathematics.

DR. TEVFIK SAGLAM, professor of internal diseases in the faculty of medicine, has been appointed rector of the University of Istanbul.

IT is reported in the *Journal* of the American Medical Association that as a result of the Ramirez government's order that all office holders who signed a recent pro-democratic manifesto be dismissed, professors of the highest standing in the universities of Argentina, including Dr. Bernardo A. Houssay and Professor Alejandro Ceballos, have been affected. Ramirez is understood to have stated that, besides being dismissed from public office, these men will not be allowed to leave the country.

DR. KARL F. HEISER, director of the laboratory of psychology at Norwich State Hospital, Connecticut, has been appointed research director for the State Public Welfare Council.

DR. LOUIS WALDBAUER has resigned as associate professor of analytical chemistry and head of the analytical division of the department of chemistry and chemical engineering of the State University of Iowa, to become an analytical research chemist at the Cen-

tral Research Laboratory of the General Aniline and Film Corporation at Easton, Pa.

DR. A. R. PATTON, head of research in the department of chemistry of the Montana Agricultural Experiment Station, has become a research chemist in the Biological Laboratory of E. I. du Pont de Nemours and Company, New Brunswick, N. J.

ARTHUR W. GELBKE, for the past two years director of engineering for American Type Founders, Inc., has been appointed chief engineer of E. Leitz, Inc., makers of Leica cameras and technical instruments.

COLONEL EDGAR ERSKINE HUME, Medical Corps, U.S.A., has been named chief American Health Officer of the Allied Military Government of Occupied Territory in Sicily.

IT is reported in *Chemical and Engineering News* that C. C. Concannon, chief of the Chemical Unit of the Bureau of Foreign and Domestic Commerce, Department of Commerce, planned to leave for Santiago toward the end of October to act as consultant and adviser to the Chilean Government on matters relating to the development of various branches of the chemical industry in that country.

DR. J. F. G. WHEELER, lately director of the Bermuda Biological Station for Research, has been appointed marine biologist in Mauritius. *Nature* states that it is hoped that Dr. Wheeler's researches may be a prelude to the establishment as a permanent institution of a Fisheries Department for Mauritius. The development of the island's fisheries has been made possible by a grant up to £4,500 under the British Colonial Development and Welfare Act of 1940.

DR. HAMILTON H. ANDERSON, professor and head of the department of pharmacology at Peiping Union Medical College, Peking, is reported to be one of a group announced by the State Department as being repatriated by the Japanese.

DR. F. J. W. ROUGHTON, F.R.S., fellow of Trinity College, lecturer in physiology at the University of Cambridge, will deliver the second Harvey Society Lecture of the current series at the New York Academy of Medicine on November 18. The title of his address will be "Recent Work on the Respiratory Chemistry of the Blood."

DR. EDWARD A. STRECKER, professor and head of the department of psychiatry of the School of Medicine of the University of Pennsylvania and consultant in psychiatry to the Army, Navy and Air Forces, delivered the annual Walter L. Niles Memorial Lecture at Cornell University Medical College on October 19, under the auspices of the Tau Chapter of Nu Sigma Nu. His subject was "The Neuropsychiatry of Global War." The lecture is given annually in memory of Dr. Niles, a former dean of the Medical College, where he was for many years professor of clinical medicine.

THE Johns Hopkins Medical History Club commemorated on November 1 the four-hundredth anniversary of the publication of Andreas Vesalius's De Humani Corporis Fabrica Libri Septem. Dr. George W. Corner was chairman of the program. An exhibit illustrating the life and work of Vesalius was displayed in the exhibition hall of the Institute of the History of Medicine.

COMMEMORATING the four-hundredth anniversary of Copernicus at Colby College, Dr. Harlan T. Stetson, of the Massachusetts Institute of Technology, gave on October 22 a lecture entitled "The Earth and the Sun, from Copernicus until To-morrow." He also addressed the College Assembly on "Science During the War and After."

THE two hundred and fifty-seventh meeting of the American Physical Society will be held in the Technological Institute of Northwestern University on November 12 and 13 under the presidency of Dr. A. W. Hull, of the General Electric Company. There will be a symposium on the physics of rubber and other high polymers on the morning of Friday. Special papers will be presented on Friday afternoon and all day on Saturday. The dinner of the society will be held at the Georgian Hotel, Evanston.

THE fifty-second annual meeting of the Society for the Promotion of Engineering Education will be held in Cincinnati from June 22 to 25, 1944.

THE Association of Military Surgeons of the United States met in Philadelphia on October 21. The program, devoted to war medicine, included such subjects as aviation medicine, battle fatigue, use of penicillin, rescue work of hospital ships, organization of medical units, technic of self-preservation, treatment of parachute injuries, war dentistry, reduction of venereal infection, war neurosis, jungle and desert emergencies, booby trap injuries, evacuation of the wounded by air and the use of dried plasma.

THE School of Medicine of Western Reserve University celebrated its centennial on October 27 with a convocation, preceded by an academic procession in which representatives of one hundred and thirty-eight universities and colleges, delegates of twenty-one learned societies and the consuls of seven countries participated. The principal address was delivered by Dr. Alan Gregg, director for the medical sciences of the Rockefeller Foundation. Professor Howard Thomas Karsner, director of the Institute of Pathol-

ogy at the university, described the public service of the School of Medicine. The dinner address was given by Dr. Reginald Fitz, of the Harvard Medical School, who described the close relations during the last century between the Medical Schools of Harvard University and Western Reserve University.

THE centenary meeting of the Royal Anthropological Institute, London, was held on October 30 under the presidency of Professor J. H. Hutton. According to *Nature*, addresses were delivered by Sir John Myres on the work of the institute, and by Lord Hailey on "The Role of Anthropology in Colonial Development." There was a symposium on "The Future of Anthropology," in which Dr. G. M. Morant spoke on physical anthropology; Professor V. G. Childe on archeology; R. U. Sayce on material culture, and Professor R. Firth on social anthropology.

THE new home of the American Institute of Physics at 57 East 55th Street, New York City, it is hoped, if the exceptional obstacles of wartime can be overcome, can be opened at the time of the January meeting. The building, formerly a private house, will in the course of years become the headquarters of the offices of the institute and of some of its founder societies, the scene for conferences and committee meetings and generally the headquarters for American physics. The purchase price of $70,000, a bargain due to the generosity of the former owner of the house, has already been met to the extent of $51,000. The Building Fund Committee hopes to receive the contributions of those who intend to contribute but have not yet done so. Contributions should be addressed to the American Institute of Physics, 175 Fifth Avenue, New York 10, N. Y.

IT is proposed to establish a medical center at the College of Medicine of Wayne University, Detroit. The plan of development involves the expenditure of $50,000,000. A board of trustees has been incorporated, of which Dr. Edgar H. Norris, dean of the College of Medicine, is a member. Dr. Frank F. Tallman, Lansing, director of mental hygiene of the Michigan State Hospital Commission, has become adviser and consultant to the board, including the development of its Industrial Health Institute and psychiatric units. George F. Pierrot, director of the United Service Organizations in Metropolitan Detroit for the past seventeen months, has been appointed executive secretary of the finance committee. It is reported that an appropriation of $10,000 to initiate plans for the development of the center have been approved by the ways and means committee of the County Board of Supervisors.

DISCUSSION

THE BOTANICAL NAME OF THE GIANT SEQUOIA

IN the April number of *Leaflets of Western Botany*, W. A. Dayton, of the U. S. Forest Service, has presented a discussion of "The Names of the Giant Sequoia," based principally upon excerpts from 29 replies from certain Californian botanists in response to a request for information made by Mr. Dayton. The conclusions drawn are that botanical opinion in California (1) favors retention of *Sequoia gigantea* as the name of the big tree, (2) favors amendment of the international rules to conserve this name, and (3) indicates a reluctance to accept the recently proposed generic name Sequoiadendron. Some of the statements upon which these conclusions are based are rather amusing. One writer says he has "never seen or heard any name except *Sequoia gigantea*." Another says that the name *Sequoia gigantea* will remain in use because "millions of visitors come to this State [California] to view that tree." Another says, "Any change in the name would produce a distinct shock among 'plant lovers.'" Only two or three of the replies contain any reference to truly scientific or botanical considerations. I should like, therefore, to point out that since this is essentially a technical botanical question, it is to be decided on scientific grounds, without regard to the provincial enthusiasms of the residents of any particular part of the earth.

Clearly, there are only two fundamental points at issue. The first one is, Does the name selected conform to the International Rules of Botanical Nomenclature? The second question is, What are the basic biological facts? The first question I shall leave to the nomenclatural specialists, although it is worth while noting that the generally used name, *Sequoia gigantea* (Lindl.) Dene., being a homonym, is untenable under the international rules. *Wellingtonia* also is ruled out, and for the same reason. The second question, however, calls for comment, since, after all, taxonomic botany *is* a branch of the science of biology.

While it is not at all necessary to review here the important data presented by Buchholz in 1939,[1] it may be not altogether out of place to quote briefly from the recently published work of two other botanists, Looby and Doyle,[2] who, presumably, may be safely considered free from any motives ulterior to the spirit of scientific inquiry. These two botanists have come independently to the conclusion, on the

[1] *Am. Jour. Bot.*, 26: 535–538, 1939.
[2] *Sci. Proc. Roy. Dublin Soc.*, 23: 35–54, 1942.

basis of their studies of the formation of megaspores, female gametophytes and archegonia, in both the big tree and the redwood, that the two species belong to different genera. Following is a quotation from their conclusions:

Buchholz (1939c) has recently published a short paper on the generic segregation of the Sequoias. In this he tabulates numerous differences between them, and concludes that they can not be retained as species of one genus. To these points others might be added, notably perhaps the difference in wood structure in typical specimens. Many of these points may be only such as are natural to different species, but the differences in proembryo and embryogeny are more important. When to these are added the further differences in development, outlined in this paper, in gynospore origin, in tapetum, in early prothallial growth and expansion, and in maturer cellular formation in the prothallus, it is clear that the two redwoods differ essentially in practically every phase of their life-history. In no other coniferous genus have such differences between species been recorded; on the contrary, true species of any other genus show extremely close similarities in their development. The other differences noted by Buchholz (1939c) are thus given greater importance, and we, therefore, without hesitation, agree with him that the Sierra Redwood, the Big Tree, commonly now known as *Sequoia gigantea*, can no longer be retained as a species of *Sequoia*, a generic title to which *Sequoia sempervirens* has priority claim. . . .

They go on to say that they prefer to use the generic name Wellingtonia, instead of Sequoiadendron, for the big tree. That is, however, beside the point. The significant facts are (1) the two species differ essentially in practically every phase of their life-history, and (2) in no other genus of conifers have such extreme differences between species been recorded. Additional biological evidence supporting the theory that the two species are more than specifically distinct was adduced as early as 1894 by Radais,[3] who proposed two subgenera of Sequoia, subgen. Eusequoia for *S. sempervirens* and subgen. Wellingtonia for *Sequoiadendron giganteum*. In 1931, Florin[4] pointed out that Arnoldi, in 1900, and Lawson, in 1904, had presented sufficient evidence from embryogeny to show the fundamental generic differences between the two species. Doyle,[5] in 1940, has indicated that the segregation of the big tree into a separate genus is fully justified.

It may be not altogether without significance that, although not proposed until 1939, the name Sequoiadendron already has been adopted by some of the most distinguished authorities on North American botany, including Alfred Rehder,[6] L. H. Bailey[7] and several others. During the last three years several articles, in which the name Sequoiadendron has been employed, have appeared in both European and American botanical journals.

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[3] M. Radais, *Ann. Sci. Nat. Bot.*, ser. 7, vol. 19. Paris (thesis).

[4] Rudolph Florin. Untersuchungen zur Stammesgeschichte der Coniferales und Cordaitales. K. Svenska Vet.-Akad. Handl. ser. 3 vol. 10. Stockholm.

[5] *Nature*, 145: 900, 1940.

THE APPARENT TIME ACCELERATION WITH AGE

HAVING for some time given a little attention to the physiology of aging and still having a fair memory at sixty-eight, I was more amused than instructed by the current discussion in SCIENCE of the apparent acceleration of time with advancing chronologic age. This discussion reminds one of the old quip: "Married men do not live longer than bachelors, it just seems longer," of which the truth and the why depend on the individual (and his mate). When we eliminate amnesia for current events and make the comparison in matters of approximately equal desirability, anxiety and boredom, there is no difference in the estimate of time speed at six and at sixty, so far as one can rely on memory. Death is obviously not in the category for comparison, because of the limited experience and understanding of youth. At the age of 7 to 10, when I greatly desired to reach the stature, the capacity and the dignity of a grown-up man, called to mind the prospect of a brief visit to my mother or longed for the end of the current day when sound slumber would shut out the perpetual baa-ah of the sheep in my care, the hours, weeks and years seemed *long* indeed. But in those same years a day's visit with mother, an hour in the swimming hole or fishing in the river passed with incredible speed. It is purely a question of the item of particular concern (desirable or objectionable) in the thought of the individual. Age has nothing to do with the illusion. For now at sixty-eight, the days, weeks, months and years of war drag on as slowly as they did sixty years ago when I wanted to grow up in a hurry. Then, I wanted (above all things) to be a man. Now, I want (above all things) mankind at peace. The time to attain either seemed and seems unduly long. On the other hand, a day at fishing, now, an hour at attempting to teach, a conference with intelligent colleagues, verily, *tempus fugit*.

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IN a recent discussion in SCIENCE on the apparent time acceleration with age, Frank Wilen made a statement, the implications of which I should like to dis-

[6] "Manual of Cultivated Trees and Shrubs," second edition, 1940.

[7] "Hortus Second," 1941.

pute, especially since by so doing it will be possible to bring to the discussion some further matters of psychological interest.

In referring to Pitkin's "Life Begins at 40," the statement was made that "Whatever consolations the author may have adduced to support the title, realists know that at forty life begins to end, that they have gone over the top of the hill and are coasting, brakeless, toward extinction." I am a little tired of the "realists," and am not willing to admit that they "know" anything of the kind. But let that pass.

The real point of interest is Wilen's implication that (1) all persons are afraid of old age and death, and (2) that those past middle life are more afraid of it than others. I consider that an unscientific generalization, not supported by the facts.

In the first place, many young persons are more afraid of death than their elders. When I was in my twenties I felt much as if I were walking a tight-rope over an abyss. This was not unique. Hugh Walpole once said that he was pleased when he became forty because he no longer felt that "disaster is waiting for me around the corner." And it has been a habit with me now, in view of my experience, to ask my older friends how they feel about the matter. There is reason to believe that most of them are sincere. About 10 per cent. have told me that they definitely fear old age and death, about 40 per cent. have told me that it "bothers them occasionally," while those of the remaining 50 per cent. are mostly indifferent. Many, like Walpole, actually feel more confident than do the young.

There must be some reason for this confidence. No doubt part of it results from an increase in economic and social security, but there is, I believe, another reason: that having lived for a certain period gives one a subconscious confidence that he will continue to live. This subconscious feeling is so strong that even the certain knowledge that death is coming can not eliminate it from the mind. This may explain the avarice of the aged. At least this seems a reasonable conception, and I should be pleased to have the reactions of other readers to it.

By the way, do those who criticize Pitkin's book ever read it? Mr. Pitkin has expressly emphasized, at the beginning of his book, that physically one is going down hill after forty. What he maintains is that many persons have their most interesting experiences and produce their best work after that age—which is something quite different from what most persons *suppose* the book implies.

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WHY does time appear to move faster as we grow older? In SCIENCE of July 30, an answer to this question was attempted by F. N. Nitardy which suggested a measurement of time as it relates to the individual. His impressive note called forth some interesting commentaries. Dondlinger points out that "the content of the elapsed time, that is, the events, occurrences, incidents and circumstances experienced during the elapsed time, is also a factor." This happens also to have been our own contribution to the discussion—we said something to this effect in an editorial. But we went farther than that; we dwelt morbidly upon what is happening *to* a person in middle age, rather than merely what is happening all around him, and suggested that cirrhosis of the liver, and the income tax, have something to do with the sensation that time is flying faster and the jig is about up. We have since noted, in Glass's recent "Genes and the Man," the suggestion, neatly parallelling Nitardy, that "the value of a year at any age is about equal to its proportion of the total life up to that age, so that a year to a child of ten has approximately four times the value of a year to a person of forty," but with the additional comment: "Our sense of time is not based on clocks or stars or even the alternation of day and night, but on the changes *within* us as we grow and develop." (Italics mine.)

Wilen takes the view that "there are at least limited circumstances in which the time-lapse sensation does not depend chiefly on age": if a man of sixty and a man of twenty are suffering extreme hardship on a life raft, both will find time dragging slowly along. A factor which none of these contributors has taken into consideration, apparently, is the psychological make-up of persons with relation to time. Of two persons of the same age, one feels he has a mission to accomplish, a great task to perform, and he is acutely aware of time's flight; the other, an easy-going sort who merely hopes to enjoy life without accomplishing much of anything, does not feel the acceleration to a comparable degree. A good example of the type of whom it has been written—

> But at my back I always hear
> Time's wingèd chariot hovering near

was Thomas Wolfe. Wolfe felt that he had a gigantic literary task to perform; he worked frenziedly to get it all out, and he produced magnificently. He was preoccupied with time and the briefness of man's days. Whether this terrific drive hastened his death, whether he had a premonition of his relatively early end, are debatable matters. It is hardly debatable that to such a man time moves far more rapidly than it does for his less dynamic, less intense, contemporaries.

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SCIENTIFIC BOOKS

LEGENDRE ASSOCIATED FUNCTIONS

Tables of Legendre Associated Functions. By ZAKI MURSI, Cairo: E. and R. Schindler. 1941. xii + 286 pp. 22.8 × 29.5 cm.

THIS is publication No. 4 of the Faculty of Science of the Fouad I University, in the Zaafaren Palace, Cairo, which became a state institution in 1925.

Legendre's polynomial of the nth degree, or zonal surface harmonic of the first kind, may be defined by

$$z = P_n(x) = \frac{1}{2^n n!}\frac{d^n(x^2-1)^n}{dx^n},$$

which is a particular solution of Legendre's equation,

$$(1-x^2)\frac{d^2z}{dx^2} - 2x\frac{dz}{dx} + n(n+1)z = 0.$$

The Legendre functions $P_n(x)$ were first introduced in a paper of Legendre published in 1785. Legendre's associated functions of the first kind, of the mth order and nth degree, are the functions $P_n^m(x)$ defined by the equation

$$P_n^m(x) = (1-x^2)^{\frac{1}{2}m}\frac{d^m P_n(x)}{dx^m}.$$

The present table gives values of $P_n^m(x)$ for $n = 1,2, \ldots, 10$, $m = 1,2, \ldots, 10$, and for x over the range [0.000(0.001)1.000]. These values are to eight decimal places in the beginning, and to three near the end, where the values are large. Some values are given to twelve significant figures.

For purposes of interpolation the utility of the table is greatly increased by the inclusion of columns of modified second differences, the theory of which was set forth by Dr. L. J. Comrie in the British *Nautical Almanac* for 1937. A 7-place table of Everett coefficients, for using these modified differences, is given on pages 282–283; four errata in the differences in the main body of the table are noted on p. 284. The next two pages contain an Arabic translation of the preface.

The author cherishes the hope that his table attains to a high degree of accuracy. The computations were carried out in duplicate, during the years 1937–41, by the author and three assistants. Dr. Comrie differenced 6,000 entries of the original calculations and thus found ten errors. Checking was also effected by comparison with one of A. H. H. Tallqvist's tables of 1908 (*Acta Societatis Scientiarum Fennicae,* v. 33, no. 9) for the range [0.00(0.01)1.00]. This table of Tallqvist may be regarded as the first of its kind, if the less extensive one given in his *Grunderna af Teorin för Sferiska Funktioner jämte Användingar inom Fysiken* (Helsingfors, 1905) is excluded. Mursi seems to have been ignorant of the existence of G. Prévost, *Tables de Fonctions Sphériques et de leurs Intégrales* (Bordeaux and Paris, 1933). Among other things this contains a table from $P_1^1(x)$ to $P_8^8(x)$, to not more than five places of decimals, with differences.

Thus Mursi's volume makes a notable new tabular contribution in an important field. The volume is clearly and neatly printed, and the paper is reasonably good. War conditions doubtless prevented the earlier distribution of the volumes. Up to four months ago even Dr. Comrie did not know of its publication. Since such an excellent publication is No. 4 of a series issued by the Faculty of Science of this Egyptian university, only eighteen years of age, the reader may be curious as to what works are represented by Nos. 1, 2 and 3. Although I have not seen these works I learn that they are as follows:

(1) H. Sandon, *The Food of Protozoa. A reference book for use in studies of the physiology, ecology and behavior of protozoa,* 1932.

(2) [Book of the Science of Algebra and Mathematics by Mohammed ibn Mûsâ al-Khowârizmî, with commentaries by Dr. Ali Moustapha Mochrafa Bey and Dr. Mohammed Moursy Ahmed] (in Arabic), 1937. An Arabic and English edition of this work by F. Rosen appeared at London in 1831. An Arabic and Spanish edition, by J. A. Sánchez Perez, appeared at Madrid in 1916. A Latin edition by Libri was given in his *Sciences Mathématiques en Italie,* vol. 1, Paris, 1838. L. C. Karpinski's edition of Robert of Chester's Latin translation of part of al-Khowârizmî's work was published with an English translation, at New York in 1915.

(3) Mohammed Hassib. *Cucurbitaceae in Egypt,* 1938.

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MAN AND HIS PHYSICAL UNIVERSE

Man and His Physical Universe. F. C. JEAN, E. C. HARRAH, F. H. HERMAN and S. R. POWERS. 608 + vii pp. Ginn and Co. 1943. $3.25.

"MAN and His Physical Universe" is a text-book intended for a survey course in science. Such courses are taken by persons who do not intend to become professional scientists but who desire to be acquainted with the results of science for cultural or general educational reasons. The authors have approached the problem of presenting the results of the physical sciences by dividing the book into six "units," in which astronomy, physics, chemistry, meteorology and geology are discussed in turn. The sections are not

given these classical titles, as the writers wish to show how each subject is of importance to mankind. Thus, the part on chemistry is called "Matter as Organized Energy Possesses Properties Which Are Indispensable to Man," and that on astronomy "Man's Increased Knowledge of the Cosmos Has Modified His Thinking." An integrated thread of continuity is in this manner woven through somewhat diverse material, and the bearing of all the sciences on man's thought and activities is developed.

In the first section the errors of ancient concepts are described and the scientific method explained. Some of the more recent findings of astronomy are set forth. From this, the authors proceed to demonstrate how superstitions have been demolished by knowledge, and how practical use is made of astronomy in determinations of time and geographical location. The second section explains how the distinctions between matter and energy are broken down, and the third describes the many possible chemical rearrangements of matter, including a chapter on organic chemistry and one on the way chemical products add to the conveniences and pleasures of living.

The fourth unit discusses the physics of the various forms of energy and shows how all may be applied. The fifth reviews the effects of meteorology on life. The final part of the book is devoted to a discussion of geology, starting with a review of the structure of the earth and showing how geological changes are continually in progress. The evolution of the present surface conditions of the earth is traced and finally the authors treat the practical importance of geological forces which make many mineral products available to mankind.

As is inevitable in a book jointly written by several authors, there are differences in quality between the several sections. Thus, for example, in the chapters on geology the illustrations are referred to in the text and serve to illuminate the subject-matter there discussed, while in those on astronomy and physics the photographs and diagrams are too often left for the instructor to explain. Nor is the choice of illustrations in these sections as good. In some cases, as on page 83, they are more complex than necessary and contain material requiring explanations not germane to the matter under discussion. Further explanations by the instructor will be necessary on page 272, where it is stated that energy is kinetic or potential, and the student is left to wonder just how heat energy and subatomic energy are to be fitted into these two categories. On the whole, this reviewer was left with the distinct impression that the authors of the parts on geology and chemistry were better able to expound their subjects in a clear and interesting manner which covered the essential points than were those on physics and astronomy. On the other hand, the sections on physics and astronomy do contain many simple and instructive treatments such as that on latent heat. The scientific method is both praised and explained, but the student is given little instruction in its use and few opportunities to practice it himself. It would seem proper to add some problems for quantitative computation to the admirable ones calling for general discussion.

This text should appeal to the average student who did not expect to study science beyond a survey course. The writers of this book have undoubtedly succeeded in presenting the results of recent investigations to non-scientists in an interesting manner, while, at the same time, explaining how these results are of importance to mankind.

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SPECIAL ARTICLES

PERFUSION OF RAT LIVERS WITH ESTROGEN IN VITRO[1]

THE role of the liver in metabolism of steroid hormones has been a matter of interest for some time. Since the experiments of Silberstein *et al.*[2] and of Zondek[3] on the incubation of natural estrogens with liver brei the original finding that the free hormone is rapidly inactivated has been generally substantiated. Confirmation has been attained by a variety of direct and indirect approaches, including: (a) damage of the liver of rats by administration of CCl_4 and the observation of increased end-effects of both endogenous[4] and exogenous estrogen;[5] (b) demonstration of the ineffectiveness of estrogen crystals or pellets placed in sites drained by the hepatic portal systems[6,7] with similar inactivation on direct injection into the spleen;[8]

[1] Aided by grants from G. D. Searle and Company and the National Research Council Committee for Problems of Sex.

[2] F. Silberstein, P. Engel and K. Molnar, *Klin. Wochsch.*, 12: 1693, 1933.

[3] B. Zondek, *Skand. Arch. Physiol.*, 70: 133. 1934.

[4] N. B. Talbot, *Endocrinol.*, 25: 60, 1939.

[5] G. Pincus and D. W. Martin, *Endocrinol.*, 27: 838, 1940.

[6] G. R. Biskind and J. Mark, *Bull. Johns Hopkins Hosp.*, 65: 212, 1939.

[7] G. R. Biskind, *Endocrinol*, 28: 894, 1941; *Proc. Soc. Exp. Biol. Med.*, 47: 766, 1941.

[8] A. Segaloff and W. O. Nelson, *Proc. Soc. Exp. Biol. Med.*, 48: 33, 1941.

(c) perfusion of a heart-lung-liver preparation (dog) with estrone and the observation of inactivation in a few minutes with little or no inactivation by a control heart-lung preparation;[9] (d) incubation of various estrogens with liver slices.[10,11,12] Experiments involving the administration of estrogen and the isolation of excretion products from the urine have demonstrated that *in vivo* estradiol and estrone are intraconvertible in test animals and men, and that estrone is converted in large part to estriol by human male subjects (for a recent review see Doisy *et al.*,[13] Pincus and Pearlman,[14] also Schiller and Pincus).[15] The probabilities of such conversion by the liver have been investigated only by the experiments of Heller,[10,11] who obtained evidence for an apparent irreversible destruction of α-estradiol by rat liver slices and a probable conversion of estrone to α-estradiol which is rapidly destroyed.

We have undertaken the perfusion of intact rat livers with α-estradiol dissolved in a perfusion medium usually consisting of a mixture of Ringer-Locke solution and defribinated rat blood (see Table 1). Under aseptic conditions female adult rats in proestrus or estrus were rapidly bled, the liver *in situ* was then washed through with Ringer-Locke solution, dissected and cannulated through the portal vein, care being taken that the cannula contained Ringer-Locke solution to prevent air-embolism formation. The cannulated specimen was mounted in a perfusion apparatus having a pulsating flow of 70 beats per minute with a pressure at the portal vein sufficient to ensure a flow through the organ of 3 cc of aerated medium per minute (approximately 120 mm Hg). The entire apparatus was incubated at 37° C.

In order to recover the estrogens from the perfusing medium the following extraction was employed: (a) addition of an alcohol-ether mixture (3 parts 95 per cent. ethyl alcohol to one part ethyl ether) using 18 cc for each cc of blood or serum in the medium; (b) washing the precipitate formed with 95 per cent. ethyl alcohol using one-fourth to one-half the volume of the original alcohol-ether mixture; (c) the clear filtrates of (a) and (b) are combined, the ether and alcohol evaporated off and the watery residue extracted thoroughly with ethyl ether; (d) the ether extract is washed with 1 N NaOH to remove the estrogens, which are concentrated by acidifying the NaOH, extracting again with ether and evaporating the water-washed ether extract to dryness. An aliquot of this phenolic fraction is assayed with spayed rats by a modified Allen-Doisy method.[16] Separation of the phenolic extract into three fractions segregating principally estradiol, estrone and estriol respectively, is accomplished by methods previously described.[17,18] Hydrolysis of the perfusate when performed was accomplished by autoclaving at 14 pounds pressure for twenty minutes at pH 1–2.

Since it has been adequately demonstrated by Zondek[19] that rat blood exerts no effect on added estrogen, we have contented ourselves with a single one-hour perfusion through the apparatus of 3,200 r.u. of α-estradiol with perfusing medium alone (20 cc defibrinated blood plus 100 cc Ringer-Locke solution). We recovered 3,000 r.u., the 200 r.u. lost probably representing losses in manipulation although it is within the limits of error of our assay method (± 15 per cent.). Similarly 300 r.u. of α-estradiol was recovered completely in two incubations of 3 and 17 hours, respectively, with rabbit serum. Rabbit serum itself extracted by our methods contains no detectable estrogenic activity (less than 1 r.u. in 18 cc).

In Table 1 we present data from typical perfusion experiments. They demonstrate: (a) that with the larger amounts of α-estradiol the total activity of the perfusing fluid disappears rapidly, being reduced to less than one third in three hours (experiments 1, 2, 3, 4) and to approximately one sixth in six hous (experiments 2 and 4); (b) that this loss of activity is principally due to the formation of the less potent estrogens estrone and estriol (experiments 1 and 2); (c) that with smaller amounts of perfusing α-estradiol the loss of activity is more rapid (experiment 5) being practically complete on perfusion with 208 r.u. for 5 hours (experiment 6) since the liver perfused with medium alone yields a similar small unitage (experiment 7); (d) that acid hydrolysis of the three-hour (experiment 3) or six-hour (experiment 4) perfusate fails to increase the total activity, nor does the hydrolysate obtained enhance or diminish the activity of added α-estradiol (experiment 3); (e) that perfusion of the rat heart for three hours results in no conversion of perfusing α-estradiol, since the recovery observed in experiment 8 is practically all in the

[9] S. L. Israel, D. R. Meranze and C. G. Johnston, *Am. J. Med. Sci.*, 194: 835, 1937.
[10] C. G. Heller, *Endocrinol*, 26: 619, 1940.
[11] C. G. Heller and E. J. Heller, *Endocrinol.*, 32: 64, 1943.
[12] G. H. Twombly and H. C. Taylor, *Cancer Res.*, 2: 811, 1942.
[13] E. A. Doisy, S. A. Thayer and J. T. Van Bruggen, *Federation Proc.*, 1: 202, 1942.
[14] G. Pincus and W. H. Pearlman, *Vitamins and Hormones*, 1: 293, 1943.
[15] J. Schiller and G. Pincus, *Arch. Biochem.*, 2: 317, 1943.
[16] G. Pincus and W. H. Pearlman, *Canc. Res.*, 1: 970, 1941.
[17] G. Pincus and W. H. Pearlman, *Endocrinol.*, 31: 507, 1942.
[18] W. H. Pearlman and G. Pincus, *Jour. Biol. Chem.*, 147: 379, 1943.
[19] B. Zondek, "Clinical and Experimental Investigations on the Genital Functions and their Hormonal Regulation." Williams and Wilkins, Baltimore, 1941.

TABLE 1

THE RECOVERY OF ESTROGENIC ACTIVITY FROM THE PERFUSING MEDIUM IN VARIOUS PERFUSIONS OF RAT ORGANS *in vitro* WITH α-ESTRADIOL

Experiment No.	Organ perfused	Perfusion medium	Amount of α-estradiol in perfusate (r.u.)	Perfusion time (hours)	Activity recovered from perfusate (r.u.)* Total	Weak phenolic non-ketonic (estradiol)	Weak phenolic ketonic (estrone)	Strong phenolic (estriol)	Remarks
1	Liver	25 cc defibrinated blood, plus 100 cc Ringer-L.	3200	3	1000	400	400	200	
2	"	20 cc defibrinated blood, plus 100 cc Ringer-Locke	3200	6	570	220	220	132	An aliquot taken at 3 hrs. assayed 1000 r.u.
3	"	25 cc defibrinated blood, plus 100 cc Ringer-Locke	4080	3	1200† 1000‡	...	...	...	‡ of total plus 416 r.u. α-estradiol assayed 700 r.u. ‡ of total acid hydrolyzed plus 416 r.u. α-estradiol assayed 730 r.u.
4	"	80 cc rabbit serum plus 15 cc Ringer-Locke	1664	6	134† 128‡	...	...	...	
5	"	25 cc defibrinated blood, plus 100 cc Ringer-Locke	300	3	43	...	...	...	
6	"	20 cc defibrinated blood, plus 100 cc Ringer-Locke	208	5	15	...	...	...	
7	"	25 cc defibrinated blood, plus 100 cc Ringer-Locke	0	3	14	...	...	...	
8	Heart	50 cc rabbit serum plus 75 cc Ringer-Locke	300	3	270	270	4	0	

* By our assay method 1 r.u. = 0.125 microgram α-estradiol, 1.0 microgram estrone, 1.0 microgram estriol.
† By routine extraction (see text).
‡ After acid hydrolysis (see text).

estradiol fraction, the small amount (4 r.u.) in the estrone fraction being accountable to fractionation error.

These data controvert the findings of Heller[10] and Zondek[19] that α-estradiol is not converted to other estrogens by liver *in vitro*. It is possible that autolyzed tissue, as represented by liver slices or brei, may release substances (enzymes or oxidants) that are destructive, whereas the intact organ exerts no such effect. Macroscopic examination of the livers of these experiments gave no indication of retrogression or autolysis. Our data do indicate that the liver may normally be concerned in the conversion of α-estradiol to estrone and estriol observed in injection and urinary recovery experiments.[15, 20, 21]

A fractionation of the urine of male rats receiving estrone by injection indicates a similar conversion by the intact animal; furthermore, partially hepatectomized animals show less destruction of the exogenous estrogen and also less conversion than normal animals (Schiller, unpublished data).

It is notable that these data give no indication of estrogen detoxification by the perfused rat liver. Either conjugation occurs at a much slower rate than conversion or the participation of another organ is requisite. Alternatively, the conditions of our experiments result in a breakdown of a detoxifying mechanism in the liver.

Details of these and related experiments will be published elsewhere.

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[20] G. Pincus, *Symposium Quant. Biol.*, 5: 44, 1937.
[21] G. V. Smith and O. W. Smith, *Am. Jour. Obst. Gynec.*, 39: 405, 1938.

INABILITY TO PASS PRIMARY ATYPICAL PNEUMONIA TO HUMAN VOLUNTEERS[1]

THE chief obstacle facing investigation of the etiology of primary atypical pneumonia (pneumonitis) has been the lack of suitable laboratory animals which regularly exhibit pneumonia after intranasal inoculation with throat washings, sputum or lung specimens from sick patients.

Stokes *et al.*[2] and Reimann[3, 4] among others have reported indifferent results after previously obtaining a passage virus. Recently Dingle *et al.*[5] have reported

[1] Published with the approval of the chief of the Bureau of Medicine and Surgery, United States Navy.
[2] J. Stokes, Jr., A. Kenny and D. Shaw, *Trans. Coll. Phys.*, 6: 329, 1939.
[3] H. Reimann and J. Stokes, Jr., *Trans. Asn. Am. Phys.*, 55: 123, 1939.
[4] H. Reimann and W. Haven, *Arch. Int. Med.*, 65: 138, 1940.
[5] J. Dingle *et al.*, *War Med.*, 3: 223, 1943.

that an agent isolated by one of their group could be passed directly to the cotton rat, but not after filtration through a Berkefeld N filter. The relation of this virus to pneumonitis has not yet been established.

Following an outburst in 1942 of continued and sporadic cases of primary atypical pneumonias, occurring in male personnel, several hundred mice, 12 ferrets and 8 hamsters were given intranasal inoculations of pooled and unpooled throat washings and sputa from acute x-ray positive cases. The results obtained were insignificant. Mice would die with some regularity if unfiltered washings were used. Where Berkefeld V filtration of throat washings and ground sputum was used intranasally, occasional mice of a series would die in 7 to 12 days, or longer, but successive serial transfers of the sterile lung suspensions were negative.

In 1942, sputum and nasal washings were collected from twelve patients (subsequently Lygranum negative) exhibiting typical symptoms by roentgenogram of severe primary atypical pneumonia. Their sputum and nasal washings were suspended in veal infusion broth emulsified by grinding and shaking and filtered through Berkefeld V candles. Previous experiments with N filtrates had already been found to be negative for mice and 2 human volunteers.

The veal infusion filtrates were given intranasally to 5 human volunteers in amounts from 20 to 40 cc each. The volunteers remained healthy and did not subsequently exhibit signs of illness. Control mice also remained healthy.

The use of human volunteers is reported. The negative results obtained are consistent with the apparent relatively low degree of infectivity.

The twelve patients mentioned were Naval personnel. The five human volunteers were non-military personnel.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

STERILITY TEST FOR PENICILLIN

WITH the introduction of the use of penicillin in the successful treatment of systemic and wound infections caused by many gram positive and some gram negative bacteria,[1, 2, 3, 4, 5, 6] the necessity of providing a suitable method for neutralizing the antibacterial effects of this highly active substance prior to sterility test becomes apparent. The approach used in developing a satisfactory method for testing penicillin for sterility involved a consideration of some chemical or physical agent which would inactivate the substance completely and yet in itself have no antibacterial effects on possible contaminating organisms in the product.

Among the various agents tested, which appeared to meet the necessary requirements given, were two enzyme preparations, Taka-diatase and particularly Clarase,[7] a more active diastatic enzyme system. These enzymes were found to inactivate the antibacterial effects of penicillin in two hours or less when incubated in the presence of the agent in a water bath at 40° C and tested by the Oxford cup-plate method. Taka-diastase was effective under these conditions at pH 6.0 and 8.0 but not in buffer solution of pH 4.0. Clarase, on the other hand, neutralized penicillin activity completely at all the pH ranges given. Additional studies on the relative inactivating actions of the two preparations indicated that while Taka-diastase was effective in this test in dilutions of 1:200, a similar action was had with Clarase in a final dilution of 1:4,000.[8]

Since it was found that relatively high dilutions of Clarase would neutralize the antibacterial effects of penicillin when tested by the Oxford cup-plate procedure, it appeared worth while to study the effects of the enzyme system against the agent in the presence of a fluid medium. This study was carried out as follows: A 1 per cent. stock solution of Clarase was prepared in buffer solution, of pH 7.0 and sterilized by Berkefeld filtration. Samples of sodium penicillin powder,[9] as received in the sterility control laboratory, were inoculated with dry cultures of *Clostridium tetani, Clostridium septique, Bacillus subtilis, Eber-*

[1] E. P. Abraham, E. Chain, C. M. Fletcher, A. D. Gardner, N. G. Heatley, M. A. Jennings and H. W. Florey, *Lancet*, 2: 177, August 16, 1941.
[2] J. E. Bordley, S. J. Crowe, D. A. Dolowitz and K. L. Pickrell, *Ann. Otol., Rhin. and Laryngol.*, 51: 891, 1942.
[3] M. E. Florey and H. W. Florey, *Lancet*, 1: 387, March 6, 1943.
[4] W. E. Herrell, *Staff Meet. Mayo Clin.*, 18: 65, 1943.
[5] W. E. Herrell, E. N. Cook and L. Thompson, *Jour. Am. Med. Asn.*, 122: 289, 1943.
[6] C. H. Rammelkamp and C. S. Keefer, *Am. Jour. Med. Science*, 205: 342, 1943.
[7] "Standardized" Clarase from the Takamine Laboratories, Clifton, N. J.

[8] Details of this and additional studies on enzymes *vs.* penicillin to be published elsewhere.
[9] 10 mg containing approximately 240 units per mg.

thella typhi, Escherichia coli and *Staphylococcus aureus*. To the dry contaminated powders was added 2 cc of the prepared Clarase solution. The enzyme penicillin solutions or suspensions were transferred immediately to several tubes of Brewers' fluid thioglycollate medium (approved medium of the National Institute of Health). The contents of the tubes were mixed thoroughly by swirling and placed at 37° C to incubate. A luxuriant growth of the inoculated test organisms was had in all tubes at the end of 48 hours. Control tubes containing gram-positive organisms and penicillin, but without enzyme, failed to show evidence of visible growth at the end of 7 days incubation. However, many of the tubes containing gram-negative organisms and penicillin without enzyme showed some growth after several days. These results could be expected on the basis of known resistance of most gram negative bacteria to the antibacterial agent.

Method: With the information obtained in this and additional studies, the following method for routine sterility tests on penicillin powder is proposed. A stock of 1 per cent. sterile solution of Clarase in phosphate buffer, pH 7.0, is distributed in 2 cc amounts in sterile cotton plugged test-tubes or in ampules which may be sealed. The sterile enzyme solution, stored in a refrigerator, will retain its anti-penicillin activity for a period of at least two months. The contents of an ampule of penicillin are dissolved or suspended in 2 cc[10] of prepared Clarase solution and transferred immediately to tubes of Brewers' fluid thioglycollate medium. The inoculated tubes are placed at 37° C. and examined for possible bacterial contamination throughout a period of 7 days. An additional 7 days incubation should be allowed for detection of possible mold contamination.

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QUIETING PARAMECIUM FOR THE ELEMENTARY STUDENT

THIS new mechanical method of "hog-tying" Paramecium for classroom study has proved to be completely reliable and "foolproof" in the hands of our large student body at Washington Square College, New York University. It is somewhat simpler and more stable than the method reported recently in SCIENCE,[1] and much more dependable than any of the older methods.

The method depends upon the high viscosity, the low tonicity and the non-toxic properties of a methyl cellulose solution; and upon the fact that this solution displays very little change of viscosity as it is warmed (as by the lamp of the microscope). Best results are obtained by using a ten per cent. solution of methyl cellulose (Dow Chemical Company; viscosity type, xx low). Place one large drop of this solution on a slide in contact with an equal-sized drop of the Paramecium culture, stir the two drops together with a toothpick, put on a cover slip (no bristle or other support is necessary), and the preparation is ready for immediate study.

The slowing effect of this solution is remarkable. Now it takes the specimen about ten minutes to cross the high power (4 mm) field. Nevertheless, the form remains altogether normal, and even the rotational character of the locomotion is retained. The ciliary beat is so slow that it is quite easy to differentiate the "active" and "recovery" phases of the strokes. The progressive passage of the individual food vacuoles throughout the body can be followed (especially if a little carmine suspension is added to the culture just before mixing with the cellulose solution), and the process of defecation can be observed, as the specimen leaves a trail of fecal granules along the slow path of its progress. The untrained student also finds little difficulty in getting a good look at the other structures of the specimen, including the pulsating contractile vacuole, the gullet and undulating membrane, the trichocysts and in some cases even the macronucleus.

The further advantages of this method are inherent in the stability of the methyl cellulose solution and of the resulting "wet mount." Even without sterilization and at room temperature, the stock cellulose solution will keep for months. The "wet mount," due to the very slow evaporation of the solution, far outlasts any ordinary preparation. Without any attention at all, it does not deteriorate appreciably in two to three hours.

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[10] This quantity of Clarase solution will inactivate as much as 50 mg of penicillin containing a total of potency of 10,000 or more Oxford units.

[1] John B. Buck, SCIENCE, 97: 2526, 494, May 28, 1943.

BOOKS RECEIVED

BERT, PAUL. *Barometric Pressure. Researches in Experimental Physiology.* Illustrated. Pp. xxxii + 1055. College Book Company, Columbus, Ohio.

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DIXON, MALCOLM. *Manometric Methods as Applied to the Measurement of Cell Respiration and Other Processes.* 2nd edition. Illustrated. Pp. xiv + 155. Cambridge University Press. $1.75.

PORTER, C. W. and T. D. STEWART. *Organic Chemistry.* Illustrated. Pp. v + 577. Ginn and Company.

STEWART, ISABEL MAITLAND. *The Education of Nurses.* Pp. xi + 399. Macmillan Company. $3.50.

WHITEWAY, HELEN LOUISE. *Scientific Method and Conditions of Social Intelligence.* Pp. x + 188. Teachers College, Columbia University. $2.00.